

Taylor C. F.)

ON THE
MECHANICAL TREATMENT
OF
SYNOVITIS OF THE KNEE-JOINT.

BY

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box 40

[REPRINTED FROM THE NEW YORK MEDICAL JOURNAL, JULY, 1873.]

NEW YORK:
D. APPLETON AND COMPANY,
549 & 551 BROADWAY.
1873.

PROSPECTUS FOR 1873.

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ON THE

MECHANICAL TREATMENT

OF

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*Presented by
the Author*

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ON THE MECHANICAL TREATMENT OF SYNOVITIS OF THE KNEE-JOINT.

If the mechanical treatment of all diseases of the joints has its conception in a conservative idea, this is especially true in regard to synovitis of the knee-joint. Here, if anywhere, our first and last idea must be protection. Neither careful nor vigorous management, under a single idea in the treatment of this disease, can compensate for the omission of other ideas which go to make up the conservative whole involved in the term *protection of the joint*. A correct comprehension of the mechanical requirements involved, appropriate mechanical means for realizing our conception, and a patient persistence which does not tire nor attempt short passages to the end, till it is fairly reached, are the requirements needed in the successful treatment of this disease. I use the word *protection* with a purpose. Synovitis of the knee-joint, like inflammations everywhere, requires rest. But the idea of rest alone is but a feeble conception of the requirements necessary to meet all the indications which this disease presents.

The gypsum bandage gives rest from motion and partially from pressure also; so that, for a time, and to a certain extent, there follows a subsidence of the inflammatory process. But there comes a time when, after a certain degree of subsidence of the inflammation has taken place, the want of mo-

tion in the joint is injurious, because it is the withholding of the natural stimulus to the healthy nutrition of the synovial membrane, and is a direct cause of irritation ; and, after that point is reached, rest from motion is no longer protection, but the reverse. All, who have had any experience in the treatment of this disease, must have observed a persistent irritability and long-continued sub-inflammation in the later stage of treatment by rest alone, precisely similar to what we find in a healthy joint which has been, from any cause, for a long time deprived of its power of motion. Motion, then, under certain circumstances, as well as rest under other circumstances, is protective. But there may be an indication for motion, so far as the synovial membrane and the ligaments of the joint are concerned, and such motion at a certain period may be the best and only healthy stimulus to the normal secretion of the synovial fluid ; while neither the synovial membrane, the cartilage of the joint and, perhaps, the epiphyses of the bones, may yet be in a condition to bear pressure ; not even the pressure caused by the tonic contraction of the muscles, and still less can they bear pressure accompanied with weight and motion. It becomes, then, the surgical-mechanical problem to make these two otherwise antagonistic conditions harmonize.

There are other problems equally important to those just mentioned, and equally antagonistic without mechanical interference, which require solution ; such as confinement of the leg without confinement of the whole body, involving protection with locomotion as against total confinement of the person ; progressive changing of the angle at the knee, at the surgeon's option, with a view of preventing or removing distortion ; motion or rest, or both alternately, under the same control ; complete relief from pressure in the joint or partial pressure, according to the degree of recovery and consequent increased ability to bear it, at different stages of the process of resolution ; in a word, to be master of the situation, and to be ready and able to respond to any and all indications, separately or at the same time, constitute the problem of the mechanical treatment of synovitis of the knee-joint.

The following is a description of the construction and use

of an apparatus which is designed to solve the mechanical problem above mentioned, and, through this means, to place all the indications presented by the inflammations of the synovial membrane of the knee-joint directly under the surgeon's control. In the first place, it is necessary to grasp the limb easily but firmly, so that it may be held without motion or jar.

The apparatus consists of a steel bar, A (Fig. 1), above, and another, B, below the knee on the outside, and other similar bars on the inside, which are united by several bands which pass under the leg.

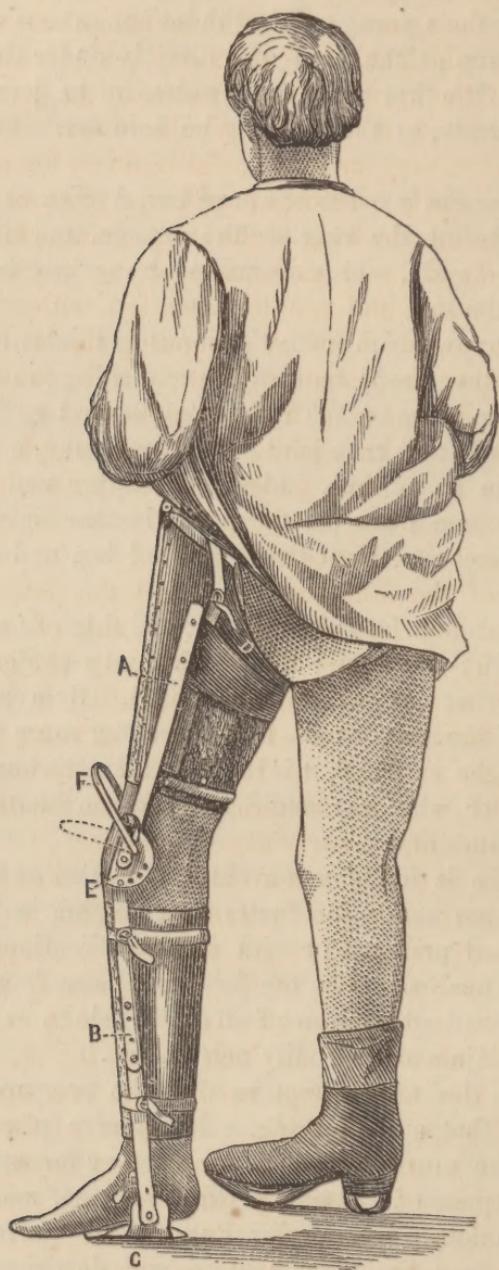
These bands which unite the inner and outer bars are important. They should be entirely unyielding, so that the inner and outer parts of the instrument cannot spring apart in the least; and, that they may not be too heavy, a vertical section ought to be concave. Inside the upper and lower portions of the frame are placed strong leather linings securely riveted. They exactly fit the thigh and leg, and are laced in front.

This arrangement grasps the leg and thigh as securely and with as much ease to the patient as a plaster-of-Paris bandage. Hence the first indication is answered. By a peculiar construction of the joint at E—to be hereafter more particularly described—the instrument is made to take the angle assumed by the leg, or whatever angle the surgeon desires, with minutest adjustability.

The knee is left free for the application of an elastic or roller bandage with opportunity for changing, with increased or diminished pressure, or with local applications, as may be desired. Thus motion in the joint is effectually stopped, and with a material which is not frail and liable to be broken, but entirely uninjurable in bodily movements.

But it is desirable to remove also the pressure within the joint. To that end four pieces of adhesive plaster are prepared in the same manner as for dressing for extension and counter-extension in disease of the hip-joint, and applied in a similar manner on the inner and outer aspects of the leg and thigh, from the knee upward and downward, with the ends, to which pieces of webbing are attached, reaching near-

FIG. 1.



ly to the ankle below and to the upper part of the thigh above, where buckles are placed on the instrument to receive them. By drawing the several ends of these adhesive straps applied as above described, effectual extension and counter-extension are made at the knee and the pressure in the joint wholly or partially removed, at the surgeon's discretion. The knee is a true hinge-joint, very strong to resist ordinary force, but whose ligaments are easily overcome in relieving pressure in this manner. The forcible drawing of the straps and buckling the ends at the upper and lower extremities of the instrument afford sufficient extension and counter-extension without the intervention of screws or means of elongating the instrument.

But, another important indication is, to make available the hygienic influences of fresh air and exercise. Many cases of synovitis in the knee-joint, which are simple and incipient, improve for a time under total confinement, but, after a while, become worse as the patient sinks for want of fresh air and exercise. Hence the tendency with every partial subsidence of the inflammation to get the patient off from his bed and out into the air, at the risk of redeveloping the disease by premature use of the only partially-restored joint. It is a constantly-recurring question in cases treated by total confinement, which is the greater risk: to keep the patient longer confined, to the certain deterioration of his general health, with its deleterious effect on the disease; or to take the chance of too early use of the knee.

This difficult dilemma is avoided in the following manner: The lower portion of the instrument—which may be lengthened or shortened at B, to get exactly the proper length—extends to near the sole of the foot, where it is jointed on both sides to a foot-piece of steel, C, which rests beneath the foot and about half an inch below it; or, so far that the sole of the foot cannot reach it to rest upon it when the patient steps in walking. No part of the weight of the body rests on the adhesive straps, they being used solely for the purpose of obtaining extension and counter-extension, as previously described. But, for the purpose of supporting the weight of the body on the instrument alone, a thin plate of steel is fastened to the outer portion of the frame

of the instrument, extending to above the trochanter major, curved to fit the thigh, and of a width equal to about one-fourth of its circumference. To this the leather lining, which laces around and firmly holds the leg, is attached. A piece of thick steel is riveted across the top, to add strength, and from the posterior upper corner the strong webbing band D is fastened, which, after being incorporated with the upper edge of the lining, cut to fit the part, passes under the ischium and around the thigh, and is fastened to a buckle on the upper anterior corner of the plate.

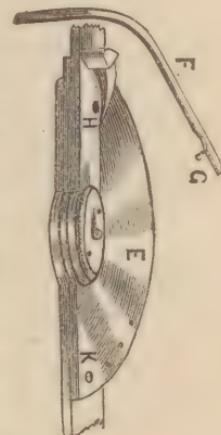
The arrangement is in such a manner as to receive the whole weight of the body without yielding. The instrument thus becomes itself an ever-present crutch for the purpose of supporting the weight of the body during locomotion. The foot-piece, C, occupies so little space that the shoe is put on as usual, and the fact that the foot does not rest on the sole of the shoe is not observable. In very sensitive cases, arm-crutches are first given to the patient. But after a while in all cases, and from the first in most cases, the patient can walk with ease and impunity on the instrument alone. The extension of the instrument far enough beneath the foot to prevent contact adds about half an inch to the length of the leg. To compensate for this difference, the sole of the shoe on the other foot is made thicker, and, to still further save the diseased leg from accidental jars, this sole is usually made about one inch thick, so that the well leg is rather longer than the affected one. The patient can then walk with perfect ease and comfort, and the surgeon has the immense practical advantage, in employing this conservative treatment, of not being restricted as to time. In ordinary cases, during the later period, the patient can often pursue his business with impunity from injury and independence in regard to the time necessary for complete subsidence of the inflammation. Besides, he can graduate the use of the joint, either in regard to its motion or the weight it may bear, from time to time, as the case proceeds toward recovery. As a rule, motion is indicated before pressure can be tolerated; that is, motion with no pressure in the joint is found to be beneficial long before either motion with pressure or pressure alone would be

borne. To meet the requirements indicated above, the joint (E, Fig. 1), has now to be described. In the description heretofore given, this joint has been supposed to be locked at an angle to accommodate the degree of flexion of the leg. But this peculiar joint has other uses. It is constructed (Fig. 2) with a semicircular plate, E, resting between the ends of the upper and lower portions of the instrument, where they are united by a rivet at the knee. The lower edge of this disk is firmly fastened to the lower bar by a screw, K, which can be moved to any of the numerous holes prepared for it in the lower edge of the disk, and with a corresponding alteration of the angle at the joint. The upper part of the instrument is held in place by means of a strong pin, G, in the end of the spring F, which the latter forces through corresponding holes in the steel bar and disk whenever they are opposite each other. By depressing the spring F, the extremities are made to rise on the inclined planes on either side, and thus the pins are withdrawn from the holes in the disk, leaving complete freedom of motion in the joint. These pins are still retained in the holes in the steel bars, and are pressed against the face of the disk by the spring F, till they are carried opposite the holes from which the act of depressing the spring withdrew them, when the latter forces them in and the apparatus is fixed again. The usual method is to unlock the joint while in the act of sitting down. This is accomplished with a slight and generally unnoticeable movement of the hand.

This occasional bending of the knee, more or less—always without pressure—after the inflammation has subsided to a certain degree, is often quite sufficient to entirely change the character of the secretions in the joint. At a much later stage free motion at the knee during locomotion may be admissible, but not while there is much flexion remaining.

In regard to the flexion at the knee, which usually accompanies inflammation of the lining membrane of the joint, no

FIG. 2.



forcible extension of the leg upon the thigh is necessary or admissible. Forceful straightening or any thing approaching it

FIG. 3.



is not necessary, because we find that, during the conservative treatment here described, a gradual relaxation of the muscular contraction takes place with the subsidence of the inflammation.

But there should be no haste to realize the straightening of the leg. It is sure to take place voluntarily, after a while, when the treatment is carefully and steadily pursued without regard to the time it takes to arrive at the point of relaxation. As we find a gradual increase of motion in the joint, with increased ability to straighten, we have only to adjust the instrument to a different angle corresponding to the improved condition of the leg, by changing the position of the screw K, as previously described. If by accident the instrument is made too straight for the comfort of the patient, it should be at once changed to a position perfectly easy to bear.

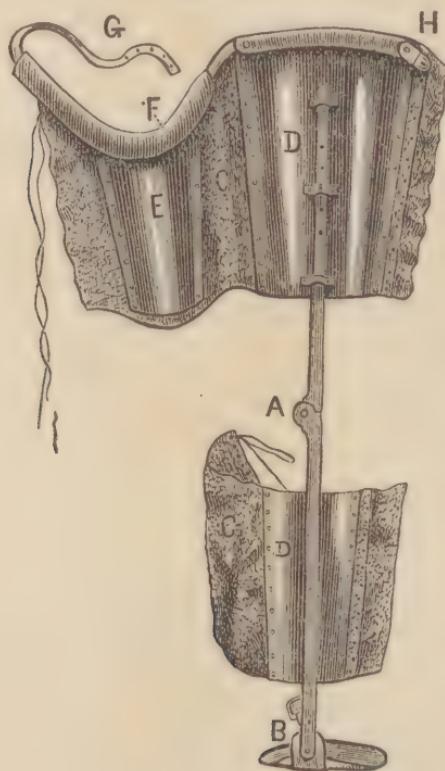
But, after the inflammation has subsided, and the muscles have relaxed till there is little or no flexion at the joint, and motion is tolerably free and without pain, we are not yet ready to allow the patient free locomotion with the whole weight of the body on the joint. We find, in synovitis of the knee-joint, that it is generally a long time after all active inflammation has subsided, before there is the same ability to bear the pressure in the joint, which free locomotion would inflict, that there was before the inflammatory process was set up. So that, if we would carry out our conservative idea to the end, we must still seek to protect the joint from the deleterious influence of pressure till it is fully able to bear it without injury. But perfect freedom of motion is safe long before the joint is capable of sustaining weight. In still further adhering to the conservative, protective idea with which we began, we at this point adopt the plan designed for relieving the whole leg—including, of course, the hip- and knee-joints—from weight in locomotion, while at the same time allowing perfect freedom of motion in every joint. With this apparatus the patient may walk about without the least restriction on his movements in every joint, while the whole or any portion of the weight of the body may be sustained by the instrument.

“This apparatus,¹ intended to sustain the weight of the body from resting upon the hip-joint—it answers equally well for the knee—without restricting in any manner the movements of the limb in locomotion, is shown in Figs. 4 and 5, and is constructed and used in the following manner:

¹ From a work in preparation on “The Mechanical Treatment of Disease of the Hip-Joint.”

"A strong upright bar of steel (Fig. 4) is jointed at A in such a manner that, when vertical, the rivet of the joint is behind the vertical line. It is evident that, with such a joint,

FIG. 4.



vertical weight would not only be sustained, but would add firmness to the supporting power.

"D D are steel plates about one-fourth of the circumference of the leg, to which are attached the broad bands of leather which lace around the leg and thigh. The lower steel plate is riveted to the upright, but the upper one is fastened by three 'keepers,' which enable it to be raised or lowered, in adapting the instrument to the length of the leg.

"B is a foot-piece intended to rest under the foot inside the shoe. The broad band of leather, C, is cut down at the top, where there is a firm pad, F, terminating in the strap, G, which, when the instrument is applied, fastens in the buckle

FIG. 5.



II. The leather, C, has the thin metal plate, E, riveted to it to give it more firmness.

“ The instrument is seen applied in Fig. 5. It is adjusted

at such a length that the heel does not reach to the foot-piece, but there is a little space beneath the foot. So that the padded strap, G F, as will be seen, passing under the ischium and resting close against the perineum, is arranged in such a manner as to sustain the entire weight of the body while the patient is standing or walking. But care should be used, in applying the instrument, that it is not laced too close. The leg ought to move freely in it, so that the whole weight will rest on the padded portion at F, and not any on the leg and joint. The foot is dressed in the ordinary manner, the space between the bottom of the foot and the foot-piece being too little to interfere with applying a shoe in the ordinary manner, and the shoe itself is sufficient to keep the instrument in place. But a small piece of adhesive plaster properly applied to the leg, and the lower end fastened to the buckle near the bottom (B), is generally preferred for sustaining the instrument. It will be seen that, by the peculiar construction of the joint at A, the leg, when lifted, bends freely at hip, knee, and ankle; but when straight, as in standing, the joint is forced backward, and the instrument becomes firm and unyielding, and neither pressure nor concussion can be sustained by the joint. A person wearing such an instrument, properly applied, walks about with perfect freedom of motion, and with no appearance to others that he has a contrivance beneath his clothes which protects the hip-, knee-, and ankle-joints from all pressure or concussion. And while no injury can come to the healthy articulations from the absence of the accustomed weight upon them, so long as their motions are not interfered with, the importance of affording protection to a joint, susceptible from previous disease or in the incipient stages of an inflammation, cannot be over-estimated."

This instrument is generally made use of during the last months of the treatment of synovitis of the knee-joint, and, if its use is prolonged to several years as a precaution against possible injury, no harm can come from such use. It is far better to carry out the conservative idea to an unnecessary extreme, than by too great haste to jeopardize a cure.

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